The Science of **Transportation**

Science around us series, booklet - I

The Science of TRANSPORTATION

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The Science of Transportation

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FOREWORD

The young mind is ever inquisitive, sometimes they ask questions which is difficult to find within the limitation of the text books. This series deal with such questions emerging out of the garden and kitchen and other places; describe the amazing achievements in the field of S&T communication; describes the alternatives to the danger of chemicals that we use daily.

National Council for Science and Technology Communication (NCSTC) is an apex body set up with the objectives of communicating science and technology, stimulating scientific temper and developing scientific capability amongst the people has collaborated with Development Research Communication and Services Centre (DRCSC), Kolkata, which is devoted to spreading and popularizing environment science amongst people for last 25 years to bring out this series to demystify scientific phenomenon of science in daily life for the children. Hope the grown up will enjoy it too.

We trust that this will encourage the children to search for larger picture, dig deep in to the mysteries of science & successes of technology and of course sustainable living alternatives.

Dr. D.K. Pandey
Scientist 'E'

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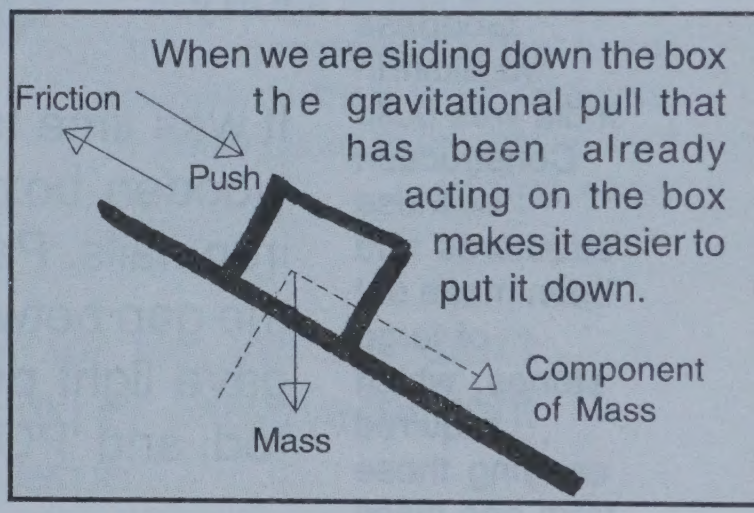
Chapter 1 Made easy transport

Anu and her family have shifted to a new house. They came in a lorry, which was stuffed with heavy packing boxes.

After reaching the house it was time for unloading. Anu has never seen such a mess. The boxes were too heavy to push or be dragged.

what a mess!

Anu saw one of the packers brings a wooden plank. What will he do with that?


When we are sliding down the box the gravitational pull that has been already acting on the box makes it easier to put it down.
Friction
Push
Component of Mass
Mass

"This is a very simple machine, but this makes things very easy. Everytime we lift something we find it difficult because bigger the object - more the gravitational pull on it" – Papa was explaining.

"Papa, I know gravitation, It is the force by which the earth is pulling everything to her centre" – Anu quoted from her Physics book.

"Good. When we try to lift anything, we actually work against the gravitational pull. So it's hard to lift the box and then put them down vertically. If we slide it down, the load can easily be made to move" – Papa pointed out.

"But it is not a *machine*" – Anu was not satisfied.

"Of course it is. **Machine is a device which helps us to work more efficiently.** Even while pouring water through a funnel, you are using a machine." – Papa ran towards the lorry.

It was time to open the boxes.The lids of the wooden boxes were hammered tightly with iron nails. Papa took a long rod, inserted it in the gap between the lid and frame of the box, gave light pressure on the other end of the rod, and 'POP' - out came the lid.

"Papa is this a machine too ?" Anu smirked.

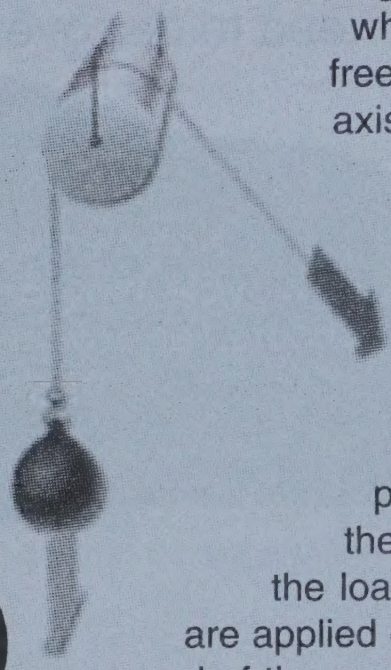
In ancient days, great structures like pyramids of Egypt or the temples of Goddess Minakshi in India was built. Construction of these structures had been made out of large stones, which required carrying those from one place to another. Even today scientists wonder how it was possible to carry such large blocks of stones to the top of the great pyramids. Some say they used pulley.

Machines are of basically 5 types. Inclined plane, a screw, a lever, the pully and wheel and axcel.

A lever is a rigid bar either straight or curved, which is free to turn about a fixed point (fulcrum).The distances of load and its effort from the fulcrum are known as load arm and effort arm respectively.

"Yes it is. **This is a 'lever'**."
"Have you ever seen people fetching water from well ?" Papa asked.

There you must have seen that the rope runs along a wheel attached with a wooden pole. That is a pulley. When neither a lever nor an inclined plane will do to lift a large load a pulley is often used.

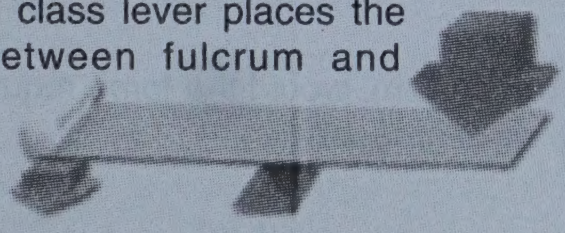


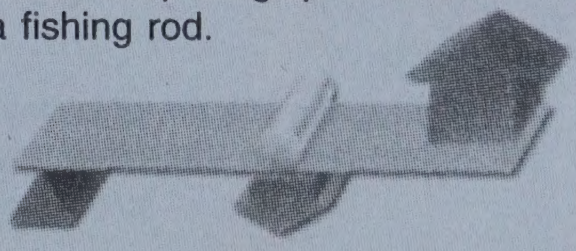
A pulley consists of a wheel with a grooved ring which rotates freely about an axis supported with a framework. In case of the single fixed pulley a rope is passed over the wheel and the load and effort are applied one to each end of the rope. The chief advantage to use this pulley is that it is more convenient to pull downwards than to lift upwards. A single pulley is actually a lever of first class.

"Yes, I have".
"Papa, how surprising! We use these machines in our everyday lives which makes things easier for us, yet we don't acknowledge these as machines, isn't it? I always thought machines are something big and large."

"Machines are everywhere, all around us. All you have to do is to observe closely". Papa added with a smile.

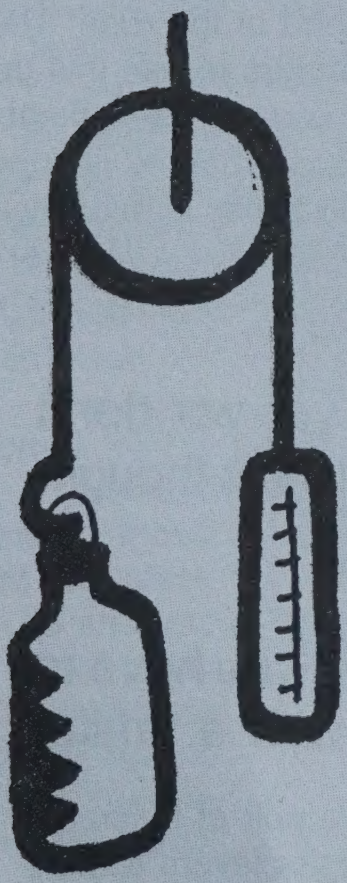
In a first class lever the effort (big arrow) and load (small arrow triangle) are on the opposite sides of the fulcrums – like crow bar or scissors. Second class lever places the load between fulcrum and effort. Like a pair of nutcrackers. Third class levers applies effort between fulcrum and load – like pulling up a fish with a fishing rod.





"Well let us do a small exercise. Here is a list of machines; we need to discover – what kind of lever is being used"

Hammer, Wheel barrow, Brake levers on bicycle, nutcrackers, wrench, Typewriter, Piano, Scissors, see-saw and a forcep. Can you identify some other in and around you?



Do it Yourself

What you need

Pulley with a hook, lengths of heavy cord (one long and one short), plastic bottle with a lid, water spring scale.

What to do

- Hang the pulley from a support, say, a door knob.
- Thread the cord around the pulley.
- Attach the hook to the free end of the cord & hang the bottle to the hook.
- Attach a spring balance on the other end, pull it. Measure the force it takes to lift the bottle with a pulley.

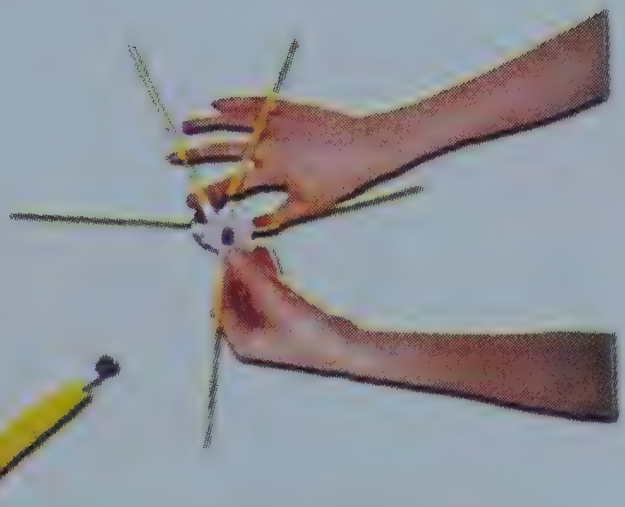
What is your observation? What is your decision?

TWISTER:

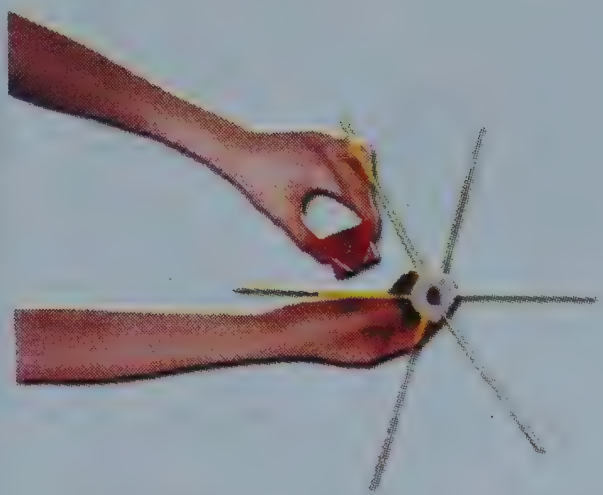
If you increase the no. of pulleys to your system, would the force required to lift the object remain the same, increase or decrease?

Activity Page

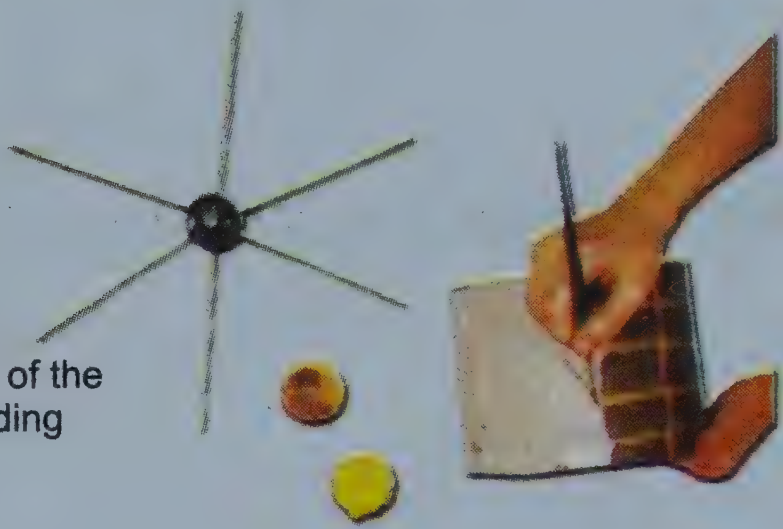
Stick 6 straws to the end of a cotton reel leaving the centre clear. Secure it with a piece of card.



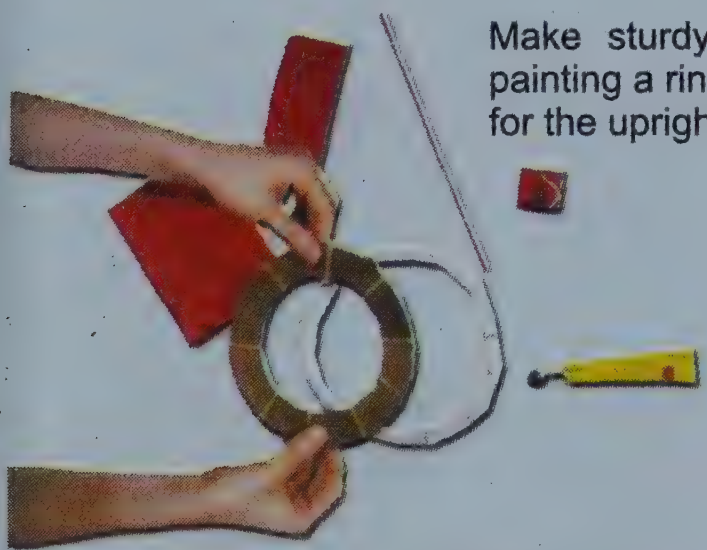
Make a little bucket from the card, and attach it to a long piece of string. The string passes through 2 holes in the top of the bucket, so that it hangs level.



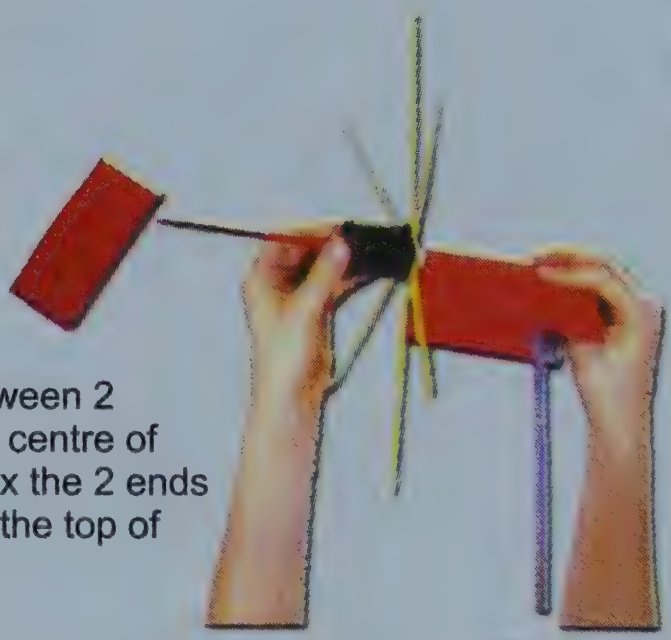
Make a base for your well from card and decorate it to give a brick effect. The top of the wall can be made by cutting slits and folding the card over.

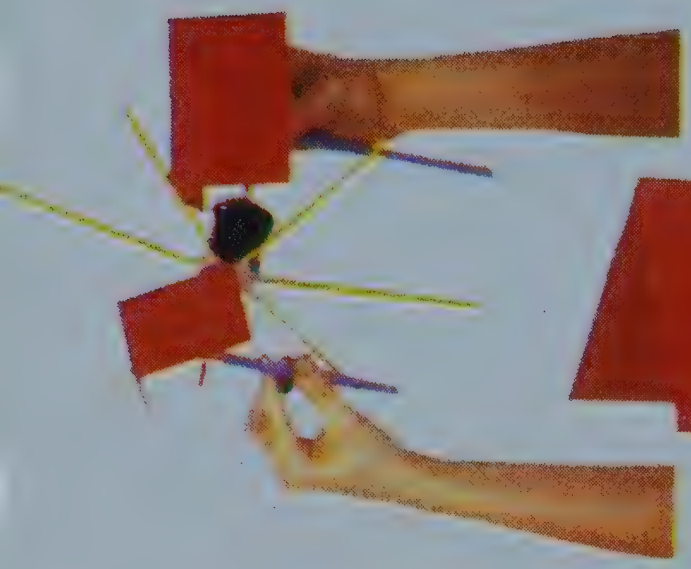


Make sturdy top to your wall by painting a ring of card. Make 2 holes for the upright support.



To suspend your wheel between 2 posts, thread a straw to the centre of the reel for your axle and fix the 2 ends with 2 large straws. Fit into the top of the wall.





The posts should be long enough to stand in the wall, giving the wheel room to turn. Add 2 little roofs made from V shaped pieces of card.

Wind your thread and bucket around the spool. Now all you need is the wind to raise and lower it. Produce this by blowing through a straw

Chapter 2 Science on the road

Yesterday, Preeti aunty came to Anu's house with her daughters, Jolly and Milly. As soon as Anu opened the door, she found Preeti aunty sweating badly and looking very irritated.

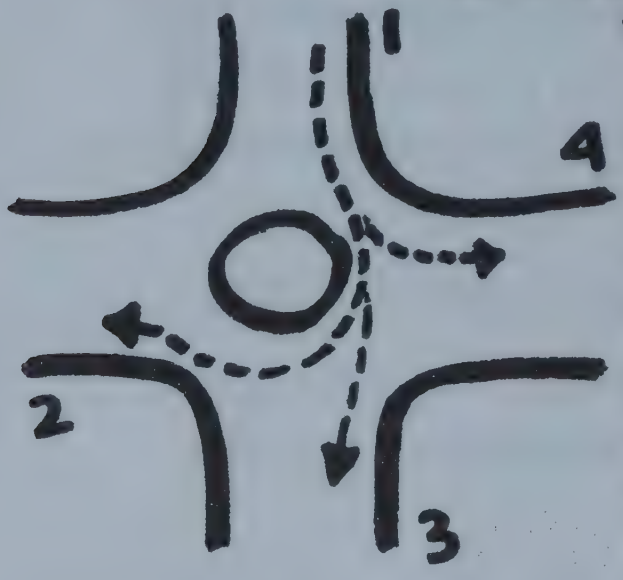
"What's wrong? Why are you so angry?" Ma asked her.

"Oh! The traffic jam! It's disgusting!! I really don't understand why there are so many vehicles on the roads." She complained.

"Because we need them". Ma replied. "Have you noticed, how the population has increased in the cities? Lakhs of people come to our city, traveling miles everyday, for their daily work."

" Stop your lecture, and give me a glass of water. If we had concentrated our efforts in developing towns outside the main city, things would not have been so difficult" - aunty was in a bad mood.

When we talk of transport we generally ponder upon the mode of transport i.e. vehicles but we do not give much thought to media of transport i.e. roads. Efficient management of traffic is not an easy thing to do.



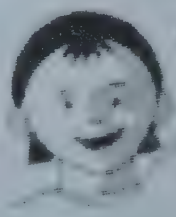
In the figure onthe left there is a road plan where four roads meet, but there is an island in the centre. Every car has to follow a particular route. They cannot move abruptly. For example a Car from Road 1 will follow the dotted route to reach Road 2, 3 or 4. In other words every car moves clockwise. Now try to find the routes that the other Cars should follow as their coming from other roads.

"But you would not deny that in the cities **we need more public transport facilities**. Else, if every single family has one car then the number of cars will not allow you to move one single inch on the road."

"Aunty, we got a new flyover in the city. Which helps me to reach school in 20 minutes, earlier it was one hour!" Anu said.

In the evening they were having tea and samosas. Jolly was very excited about her new bicycle, asked, "we have such wonderful vehicle these days. How did man travel earlier? Did they walk every time even to cover long distances?"

"Not always. No doubt walking was the primary way of going from one place to another, but animals too were used for transportation." Aunty had cooled down by now.



"We use animals even today. I know in Alaska the Eskimos use dog drawn sledges" Joly explained to her younger sister.

"Man have used horses, mules, camels to pursue journeys and carry messages", Ma added.

"I am going to the kitchen, meanwhile see the pictures of these tunnels and bridges. Without which, quick transport would not have been possible" Ma gave an encyclopedia with beautiful pictures.

"But after the discovery of **wheel**, things really changed. Wheels made carrying things easy and added speed to transport. Can you explain how a wheel works ?" ma returned back.

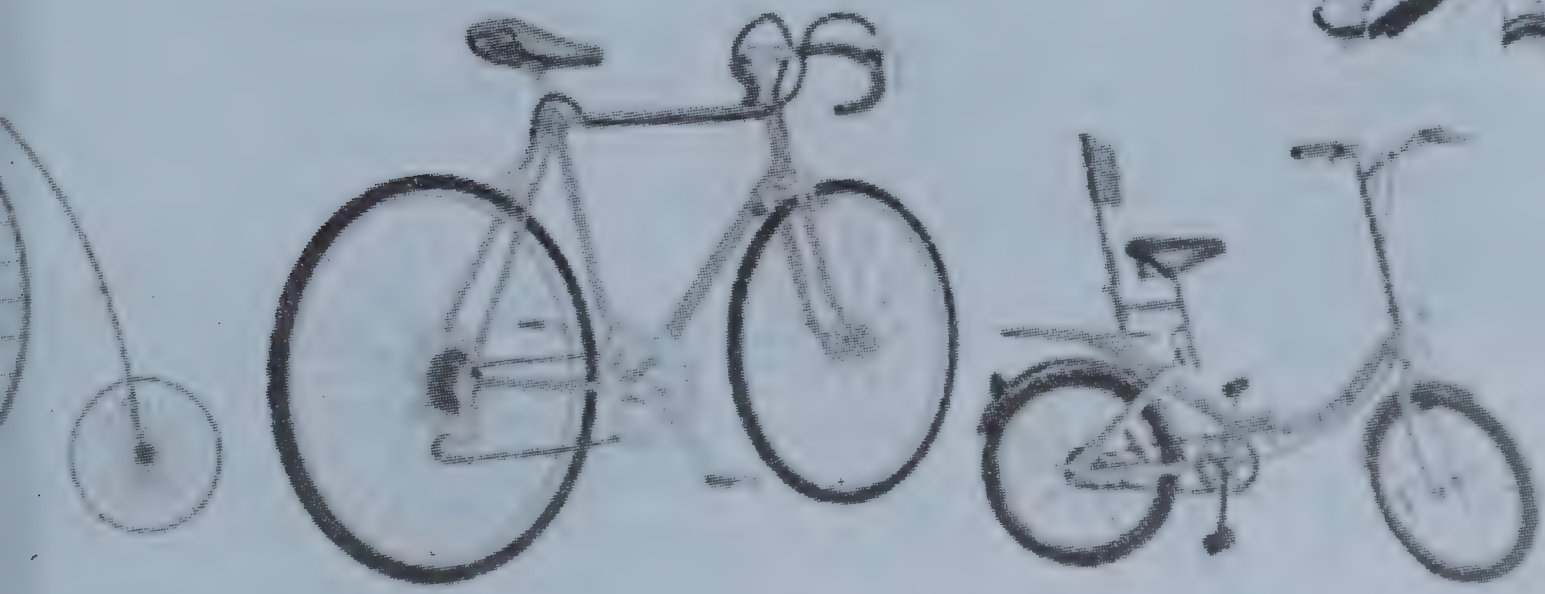
Do it yourself

What you need: Things of different shape, cube, prism, a stick, an octagon and a ball.
What to do: Make an inclined plane, roll each object one by one. Change the inclination, do the activity again. What is your observation? Which one rolls down faster and easier?
Hints: The amount of friction acting on a round is the least, which increases with the increase in the number of edges.

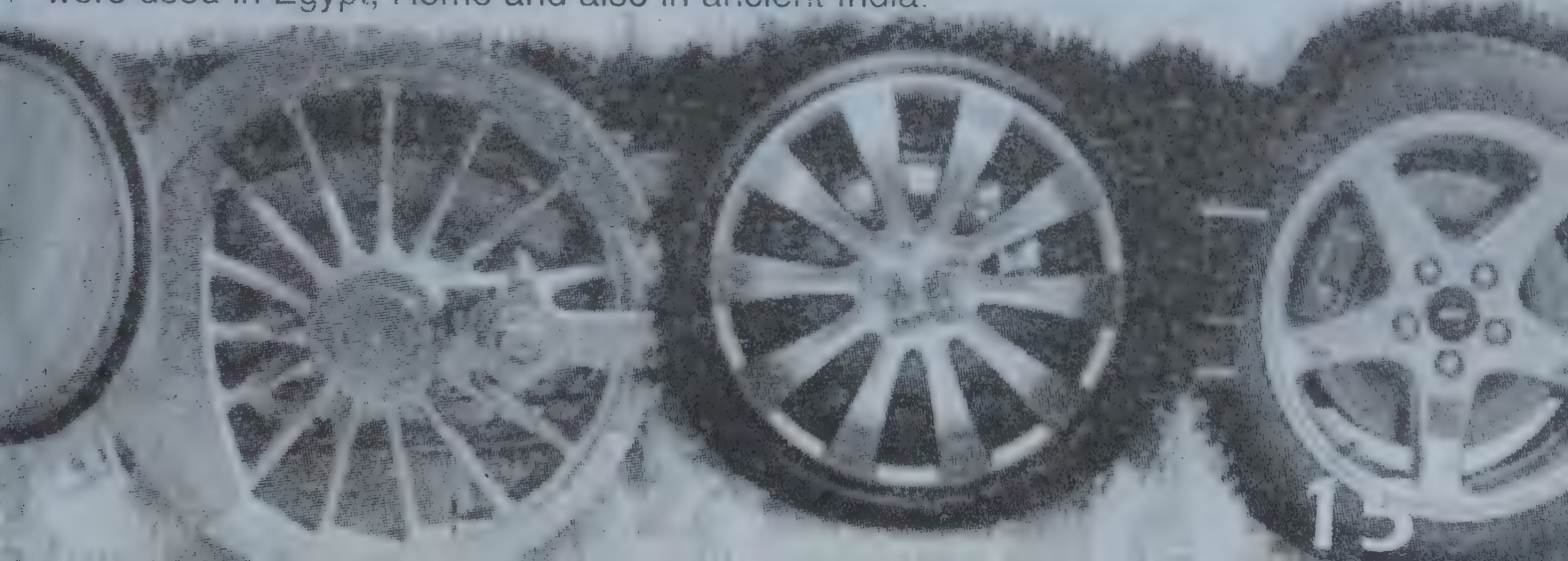
If we use wheels, the area on which friction works becomes less. No matter how smooth a surface is, every surface is irregular. It has troughs and crests. If we observe a smooth surface under microscope we can see the irregularity of the surface. So, when an object moves, the irregular troughs and crest resists the motion. Also the adhesion between the atoms of the two objects obstruct the speed.

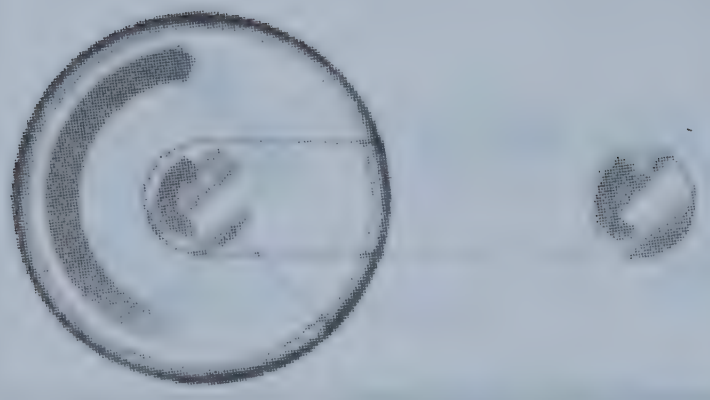
"Can you name a vehicle that runs mainly on wheels only?" asked Anu
'Cycle' ! The sisters said together.

"Yeah ! And the first cycle was even without paddles. It was a wooden structure with two wheels made of iron attached to it. The rider had to push it with his feet to go forward. It was invented by a man named Baron Van Draise in 1817, it was even named after him, Draisine".

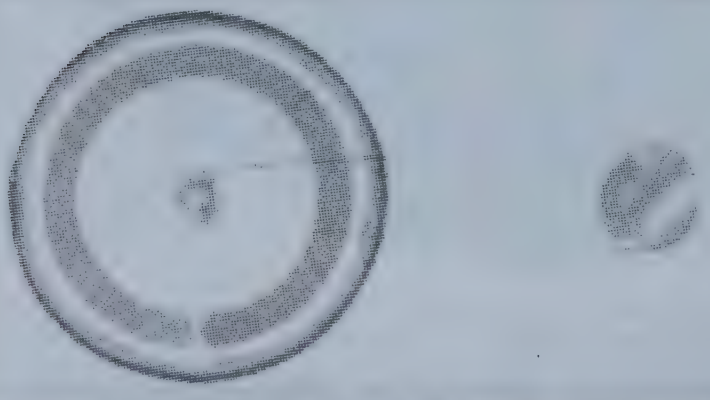


Who invented a wheel? It is not a single man who invented it. This much is known that prehistoric man (almost 4000 years ago) invented it. The initial wheels were very crude. Only a circular wooden frame with two intersecting wooden short spokes inscribed in it. This type of wheel is still used in a modified form in bullock carts. Wheels were used in Egypt, Rome and also in ancient India.





Have you heard about a **gear**?
As we turn the pedals on a bike, the large pedal gear turns the smaller gear wheel on the back wheel by beans of the chain. In the picture below, if the pedal gear has 50 teeth and the rear gear has 10 teeth, then the wheel will turn 5 times for every turn of the pedals. This is called a high gear and would be best for going on the flat ground. In the top picture, if the rear gear also has 50 teeth, that will only turn once for every turn of the pedals. It is good for climbing hills.



Mother entered the room with sweets and snacks. "Initially people used natural power like animal power and wind power. But it was only in 18th century that a French engineer, Dani Papuan used steam energy to move a wheel. In our childhood we used to travel by trains run by steam engine".

"I know. It was James Watt the Scottish Scientist, who gave modern shape to the steam engine in 1765." Jolly gave a boastful look.

Have your brain stormed

1. Why railway track is on a bed of stone chips? Why two rail lines are connected by slippers?
2. Why there are small gaps between two iron beams of a rail line?

James Watt's model of pressurized steam engine

A large amount of water was heated which caused much steam. This steam was channelised in an enclosed block which caused high pressure. The pressure was used to move the pistons attached with the wheels. While the piston moved the wheels also rolled and the train used the move.

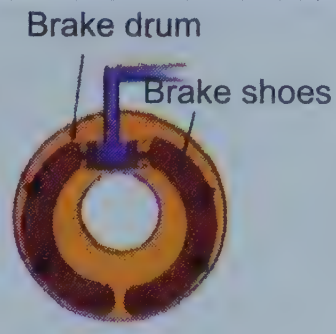
Today almost every steam engine has been replaced by oil engine, and somewhere by electric engine.

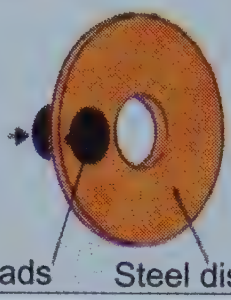
How the brakes work

When the driver presses the brake pedal, brake-shoes are forced to rub against all four wheels. When they rub together, friction stops them from moving. Friction between the brakes and the wheels makes a car slow down.

Drum brakes

The brake drum is fixed inside the wheel. So when the brake shoes press out against the drum, the wheels slow down and stop.





Disc brakes

A steel disc is fixed inside the wheel. When the brake pads press in on the disc, friction stops the wheel moving.

Trains move on the railway tracks, but how do cars move anywhere they like?" The question cropped up in Anu's head.

Activity Page

Build the main steering column for your car from a large straw. Fix a smaller piece of straw across one end to form the front axle holder.

Make the body of your car from cardboard. Cut out a shape like this one and stick the edges together. Leave a flap to cross underneath the car. This will hold the axle. Decorate with your own racing stripes.

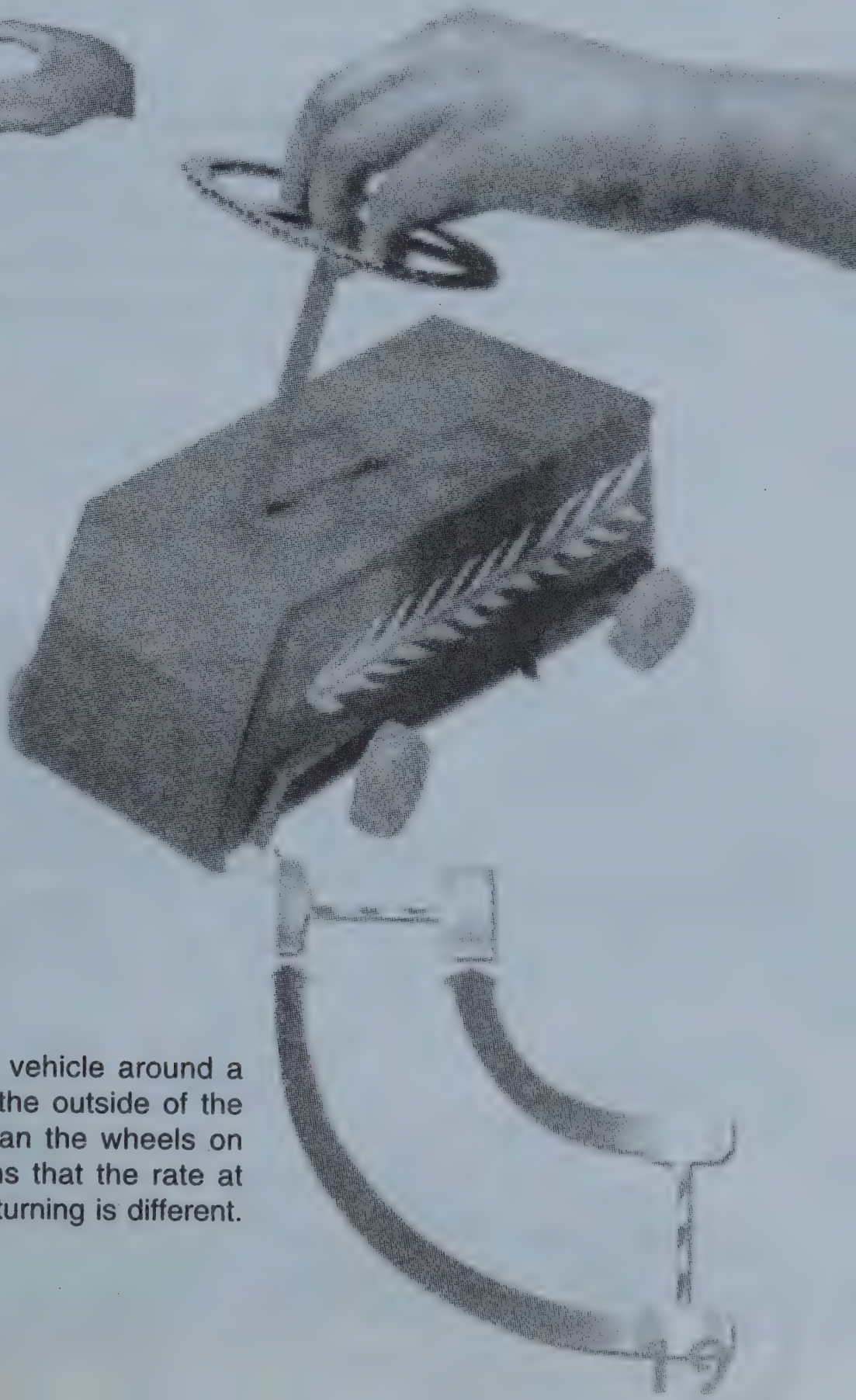
Make the axle from thin straws. These can be pushed through thicker straws and attached to the plastic bottle tops that are the car's wheels

Turn the car upside down and make a hole for the steering column to pass through. This can be reinforced with thick cardboard.

5

Pass the axles through the thick straws and attach the other wheels. You can split the ends of the straws and glue them in place. Tape the other axle in position.

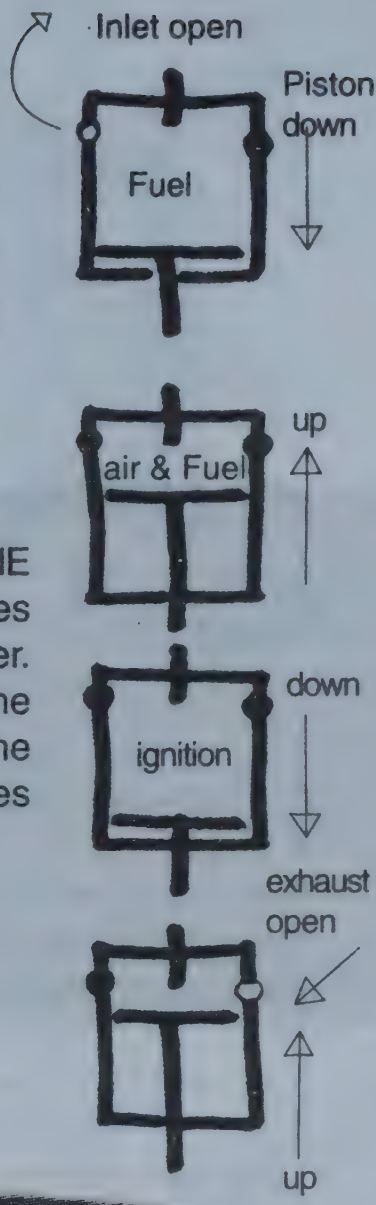
Cut holes to allow the car to sit in position over the axle, and attach the steering wheel to the column. Watch you car as you steer it around corners. Notice what happens to the rear wheels.



How it works :

When you steer your vehicle around a bend, the wheels on the outside of the bend travel farther than the wheels on the inside. This means that the rate at which the wheels are turning is different.

The era of Automobile, which moves automatically, started in mid 19th century. To day we see a wide variety and models of cars.



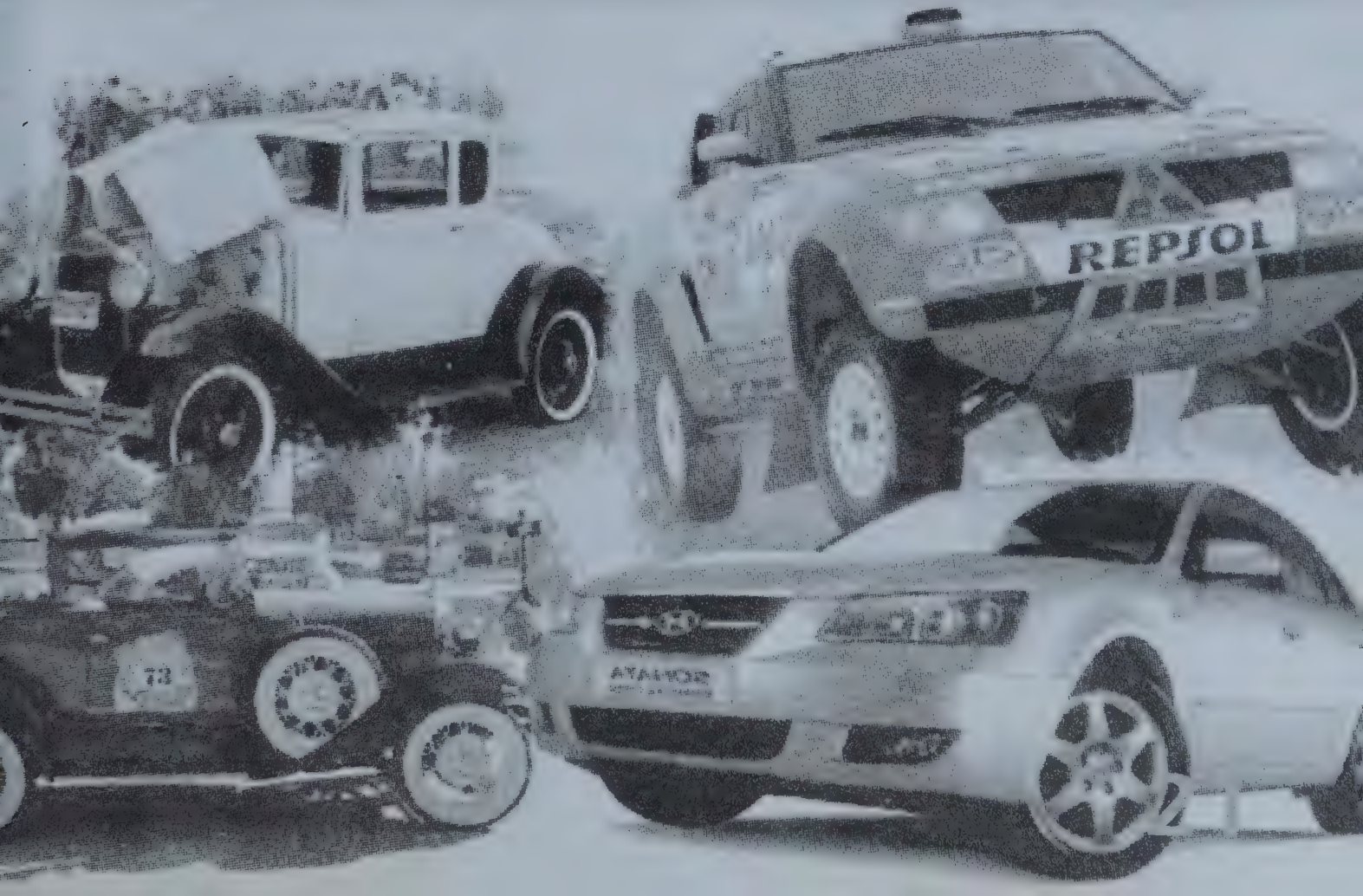
INTERNAL COMBUSTION ENGINE OR GASOLINE ENGINE :- In an Internal Combustion Engine the combustion takes place inside a cylinder. You need to mix fuel and air together. In the cylinder fuel & air get compressed by a piston. The spark plug makes a spark and ignites the mixture. The explosion pushes the piston down & the piston pushes the connecting rod which turns the wheel.

When we are consuming fuel for the sake of transportation, **are we thinking about fast exhaustion of non-renewable fuel**? The stock of fossil fuel is limited. So, continuous use will exhaust the resource. Could we think of some alternative which will save fuel and not create carbon monoxide pollution (that comes out of exhaust pipe of a car during the combustion)?

A. Electricity – fuel cell vehicles use electricity produced from an electro-chemical reaction. The electricity can be stored in batteries of fuel cell vehicles. This produces no pollution, since after combustion, the by-products are heat and water only. The only problem is that the electronic vehicle batteries have a limited storage capacity and the electricity must be replenished by plugging the vehicle into an electric source.

B. Solar Energy – Another major source of renewable energy is Sun. Silicon, which is a semi-conductor device, converts the photons from the sun into free-electrons. The electrons freed from the atoms are allowed to flow, thus producing electricity. This electricity can be put to use for various purposes.

C. Bio-diesel – Bio-diesel is domestically produced, renewable fuel that can be manufactured from vegetable oil, animal fat or recyclable restaurant grease. It has more oxygen compared to petroleum diesel. Thus it leads to complete combustion of Hydro-carbons into CO2.



Chapter 3 How things float

This summer Anu's family has decided to visit the village of Mauripur where Anu's father's relatives live. Anu is very excited, as this was the first ever in her life, that she should visit a village. One hot summer day, Anu's family reached Mauripur. The house was old but gigantic. She had never seen such a large courtyard. There was a pond at the back of the house.

One day Anu and her cousin Sumit, who was three years older than her, were sitting near the pond. A servant was cleaning the utensils, sitting near the pond. Suddenly she saw the *Kadai* floating away into the pond. She called over Sumit to help.

Sumit took a long stick and pulled the *Kadai* near the edge.

Seeing this, Anu suddenly asked his brother "Bhaiya, why does the *Kadai* float?"

Sumit, "The mystery of 'floating' is in buoyancy".

"Buoyancy! What's that?" She had never heard this word before.

Sumit, "When a solid is immersed in a liquid, every point of its surface is subjected to a pressure exerted by the liquid. This is 'upthrust' or 'buoyancy'. I shall show you something. "

Sumit took a tub, filled with water, one mug and a pebble.

"Now try to push this mug in the water vertically", Sumit said.

Anu tried to do as was asked.

"What do you feel?"

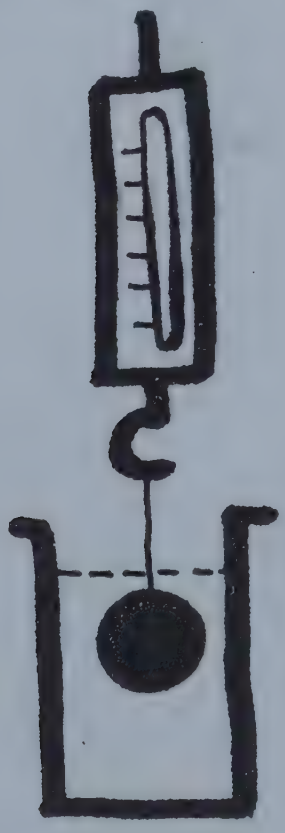
"I feel as if some force from the water is not allowing me to push the mug down."

"Yes. This upward force is buoyancy. Now see this!" He gave the pebble to Anu, and said, "feel the weight of the pebble first. Now immerse your hand in the water".

"Doesn't the pebble feel lighter inside the water?"

Anu was amazed, "Yes, it did."

"This is called apparent loss of weight. This also happens because of buoyancy. "

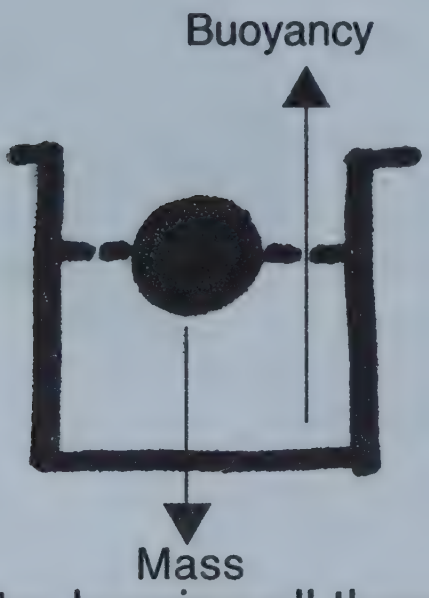


Do it yourself

Suspend a cube of copper or any other metal (heavy) from a spring balance and gradually immerse it in a beaker containing water. Note that the reading on the spring balance decreases. After the solid has been completely immersed no further decrease in weight of the solid is noted. Why is it so? Obviously the gravitational pull on the solid has not diminished. The force exerted on the solid is the upthrust or buoyancy.

The final reading on the spring balance after the solid has been completely immersed is called the apparent weight of the solid, while the difference between the actual weight and the apparent weight is the upthrust or buoyancy acting on the solid.

Now Anu probed, "If there is an upward force to support every object in water, then why things sink at all?"

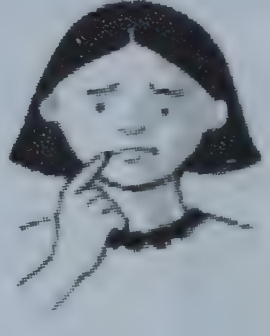


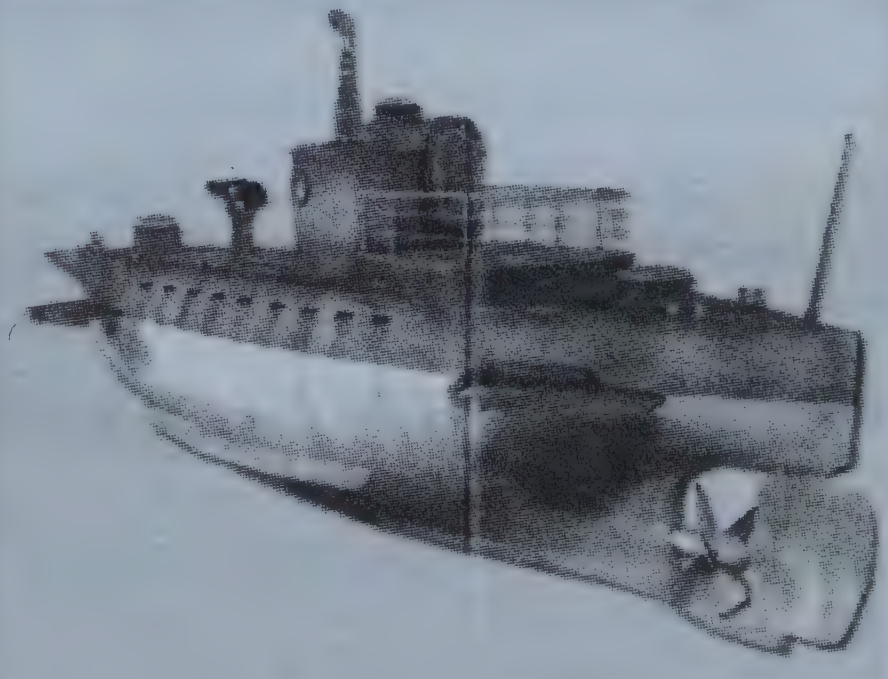
"Every object displaces water when immersed in the liquid. Buoyancy is equal to the weight of the liquid displaced by the body. If the weight the water displaced by the body is less than its own weight, the body sinks". –Sumit said

After hearing all these, Anu said "Bhaiya will you please explain me one more thing ?"

Sumit, "Well I can try".

Anu "What are Submarines ?"





Submarine is a vessel that can remain on the surface of water or sink, as desired. It is equipped with tanks which are fitted with valves through which water may enter. When water is filled in, the total weight of the vessel is greater than that of the water displaced by it, and therefore it sinks. And if desired, the water is pumped out of the tanks so that the weight of the vessel becomes slightly less than that of the water displaced. As a result the vessel comes up to the surface again.

Buoyancy of any fluid increases with its density. Sea water contains salt, so it has higher density. This makes swimming in sea easier than that in a river or pond. Dead Sea has highest density among all natural water bodies.

Chapter 4 Science on the Blue

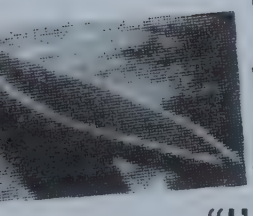
"I shall show you something. Come!" Sumit said.

He took a piece of paper, made a beautiful paper boat out of it and placed the boat on the water carefully. The boat not only floated but also moved slowly.

Wow!!" Anu was wonder struck. "It is moving like a eal boat".

Yes, It happens to be one of the oldest form of ransport for men."

"Real boats need to be rowed. Don't they?" Anu asked.



"Yes, when water on both sides of the boat is moved with oars, the water also gives equal and opposite pressure to the boat. And the boat moves forward."

"I'm sure it used to take long hours to travel by boat and so many men had to row constantly", Anu sounded doubtful.

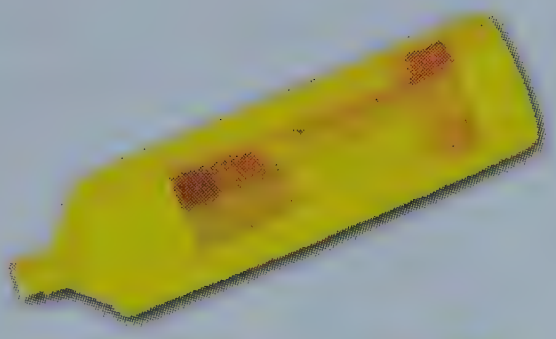
"Yes, water transport has a long history. But man was clever enough to use wind".

If we try to date back the history of water transport, we have to go long back.

In 4000BC the Egyptians made narrow boats powered by many oarsmen. In next hundred years, Egyptians started working on cotton made sails to help their boats go faster easily. Later much improved versions were prepared by Greek, Romans and Vikings.

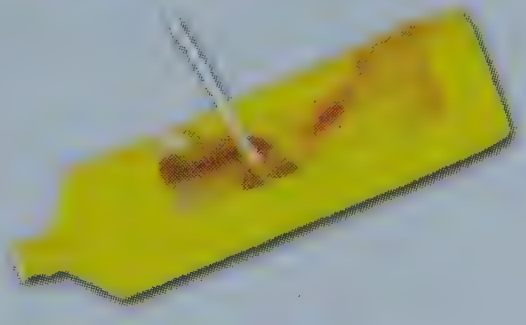
Activity Page

To make a sailboat, cut a rectangular hole in the side of a plastic bottle.



Secure a blob of clay inside the boat. Use it to hold your straw mast in place.

Cut a triangle from a piece of paper and decorate it if you wish. Pierce two holes through your sail. Feed the mast through the holes.



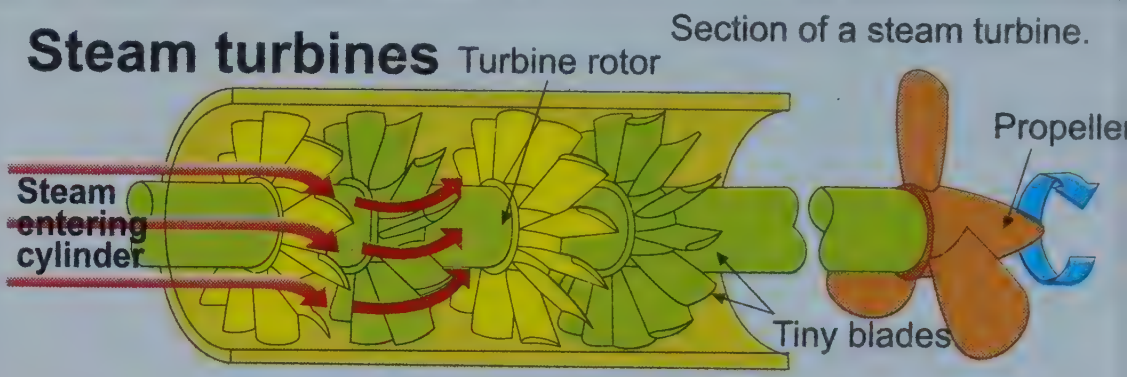
Cut a wedge shape from a carton, to make the water proof keel. Attach to the boat with a heavy mass (pudding?) attached on the narrower end.

Fill the bathtub with enough water to float your boat. Place your sailboat in the tub. Use your mouth or a hairdryer at some distance to blow on the sail, watch you boat sailing, the keel keeps the boat moving in a straight line.

"The sailors, then, must have had to wait for the wind. And what did they do when there were storms ?" Anu was not yet satisfied.

"Yes, these were no doubt some practical problems. For this, they used smaller paddle boats. Eventually we started using steam engine and then oil."

Steam turbines

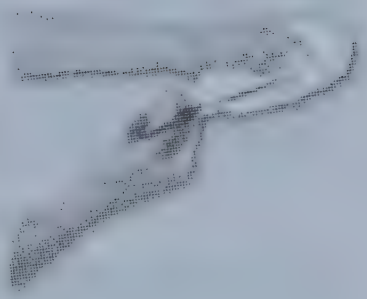


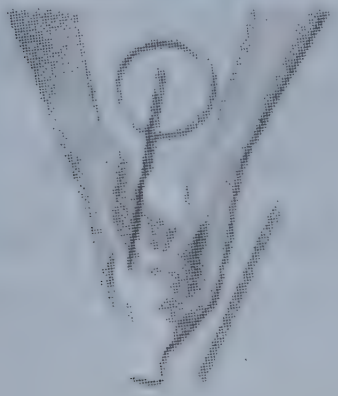
Not only by steam or liquid fuels, water vessels also move by **propellers**. When a propeller propels, a force is exerted on the water and the water exerts equal force in reaction which pushes the boat forward (Newton's Third Law of Motion)

TITANIC a British luxury ship that was thought to be unsinkable sank in the Atlantic ocean on 14th April 1942 on its route to New York from Southampton after colliding with an ice-berg. It had only 1178 life boats for 2224 passengers! There were several other trans-atlantic gigantic ships which were like almost a city!

Activity Page

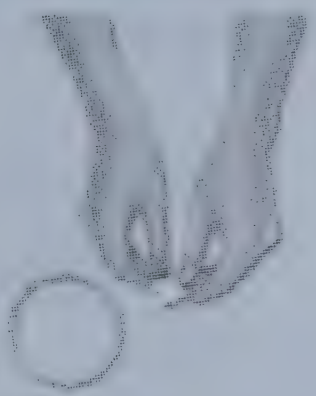
Take a small plastic bottle with a top and cut a whole in one side, large enough for a cardboard tube. This cardboard tube will be the funnel of your paddle steamer.



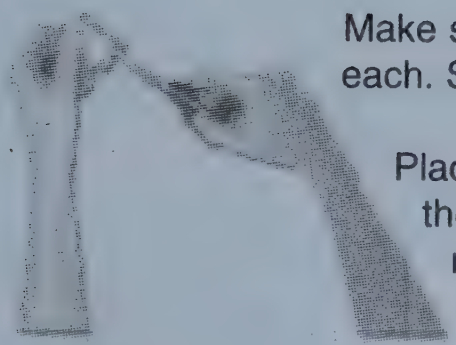


Tape two sticks or pencils on either side of the bottle. They should stick out about 2 inches past the bottm of the bottle.

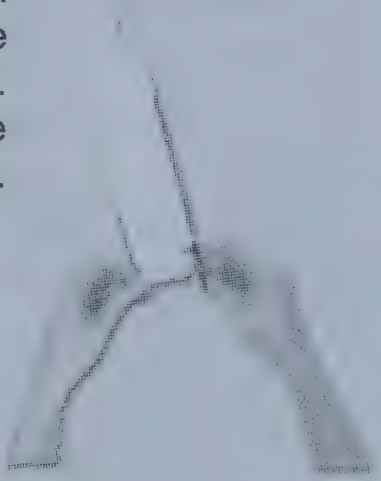
Cut out two rectangle from a thick plastic coated carton. Make sure that they are smaller than the base of the bottle



Make slit halfway down the middle of each. Slide them together to form a paddle



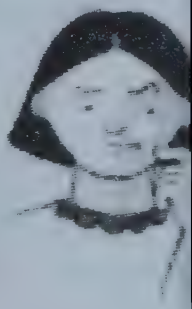
Place the paddle wheel in between the sticks. Loop the ends of the rubberband around each stick. Make sure that the paddle wheel is not touching the bottle.



Weigh the boat down with clay. Fit the cardboard tube in the whole. Wind up the paddle around the rubberband. Place the boat in the water. What do you see?

"So, today ships use petrol."

"Yes, they do. But today people usually do not travel by ship. But around sixteenth and seventeenth century, many sea voyages were conducted, that led to so many discoveries of routes. Nowadays, ships are mainly used for transporting cargo. But there some problems related to it". – Sumit said.



One of the major problems related to cargo ships is OIL SPLIT. Oil splits can occur when tankers collide or run ashore, or when pipelines break or it can occur when oil is transferred from one ship to another.

Oil split can affect severely the marine flora and fauna. The other sea birds that eat the contaminated food also die. Fishermen also lose their job, as oil kills a large number of fishes. Often the price of the oil also goes up.

Chapter 5 Fly High

"Gas balloons, gas balloons."

Anu bought two balloons. Holding those in her hands, she was walking through the fair. And almost immediately, she found, she lost both of them!

"Hey, where are your balloons? they are flying up in the sky" – father shouted. The balloons were going up and up.

"But Papa, I never thought they would go up!" Anu was more curious than upset.

"These are hydrogen balloons" he said.

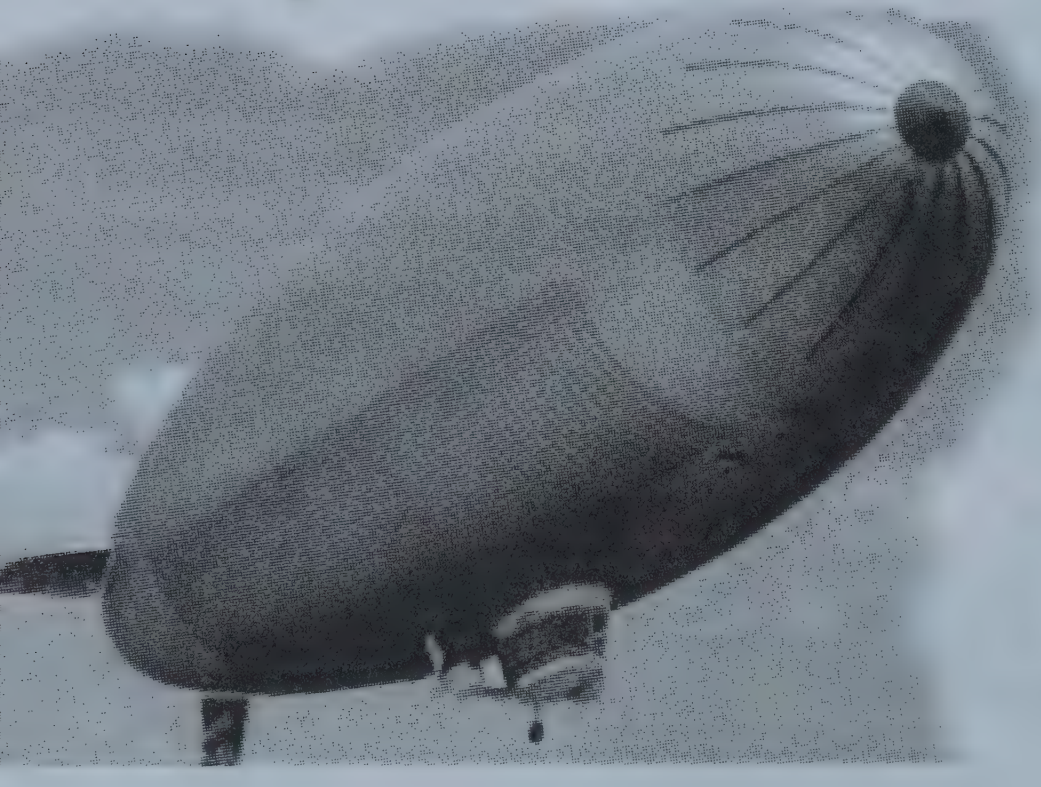
She looked inquisitively.

"Hydrogen is a gas that is lighter than air. So if we fill hydrogen in the balloon, it can float. If we had used hot air, it would have been the same thing," he explained.

"Mongolfir, a French, was the first person to fly a hot air balloon. But the interesting thing is that the first living being to enjoy the air flight was not any human, but a dog, a goose, and an ass."

"Then the balloons must have been filled with hydrogen. How did they inflate it ?" Anu asked.

"The balloons were made of cloth. A stove was attached at one end of the balloon. On lighting the stove, the air in the balloon used to get heated. There even used to be a basket where people used to stand."



Zeppeline were huge air ships, which were double layered unlike the balloons. Hydrogen was filled in the space between two layers. There used to be large space for boarding passengers. The largest airship Hindunberg met an accident when the hydrogen ignited and burned it before landing on New Jersey on May 6, 1937. 36 people were killed.

Anu interrupted "this I can understand, but if we attach wings to our hands, we won't be able to fly. Why? The birds can do it easily".

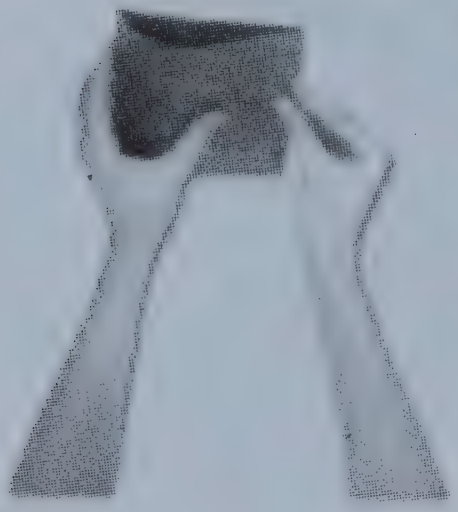
"Many people broke their limbs while trying to fly. But in 1903, the Wright brothers discovered that it did not matter whether the wings were made of something as light as a feather or as heavy as metal. It was the shape of wings which gave them the lift."

The Wright brothers, Orville and Wilbur Wright designed the first 'heavier than air' flight. They experienced the flight on 17th December 1903. The first flight lasted for 12 secs., covered a distance of 36.5 m. at an altitude of 3m and had an air speed of 48 cm/hr. while the 2nd flight was by Wilbur Wright for 59 secs on the same day.

Activity Page

To make your own flying wing, you need hard yet flexible board tag measuring about 4"-6".

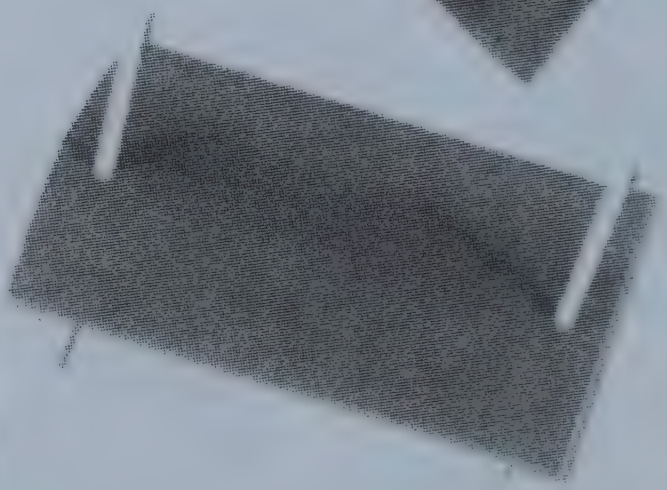
Fold the board in two, leaving an overlap around .5"

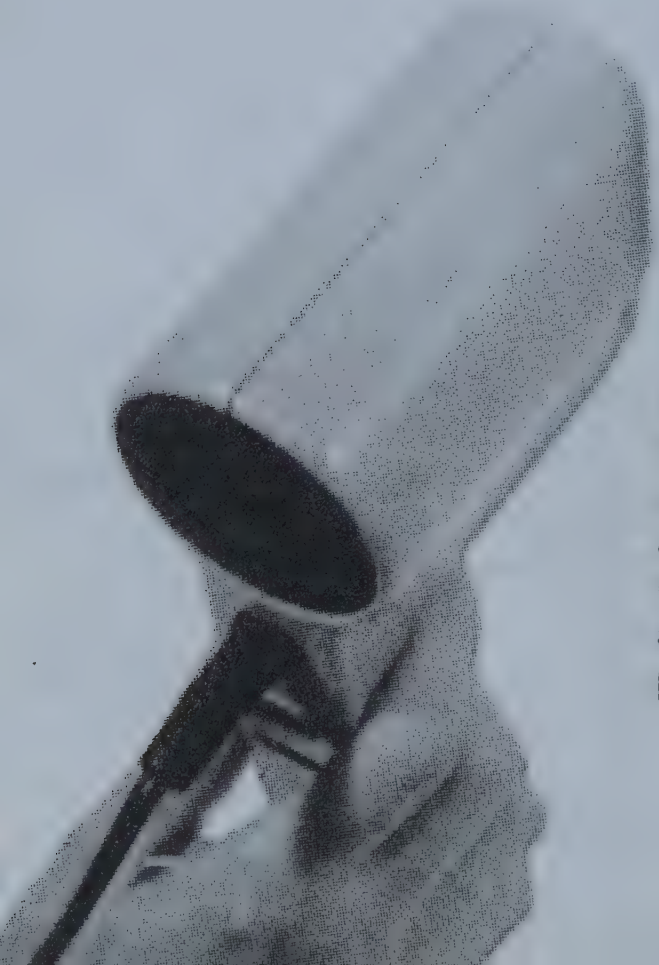


Push the overlapping ends together. This will make one side of the folded paper curve up. Tape it in place.

Use a pen to pierce holes through the wing (top and bottom) as shown.

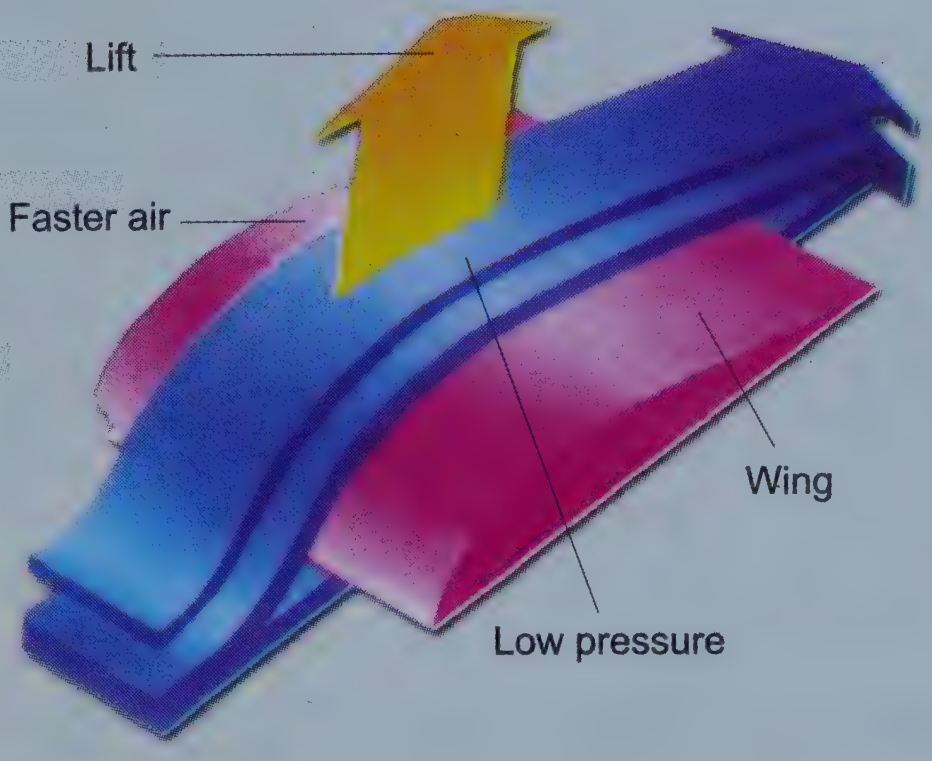
Carefully push a drinking straw through each set of holes.





Pull a long piece of thread through each straw. Pull these tracks tight and fix them straight between a floor and table, so the wing slide up and down freely. Lift the wing up a little and aim a hair dryer at the folded edge. Turn the dryer on, and watch your wing soar. Make sure you are pointing the dryer straight for the best lift.

How it works: Your airfoil rises because of its shape. The top surface of the wing is longer than the bottom. Air passing over the top of ythe wing has fatrther to travel – so it has to go faster. Faster moving air has lower pressure. (Remember Bernouli effect!) Low pressure above the wing causes it to lift.



Forces on a plane

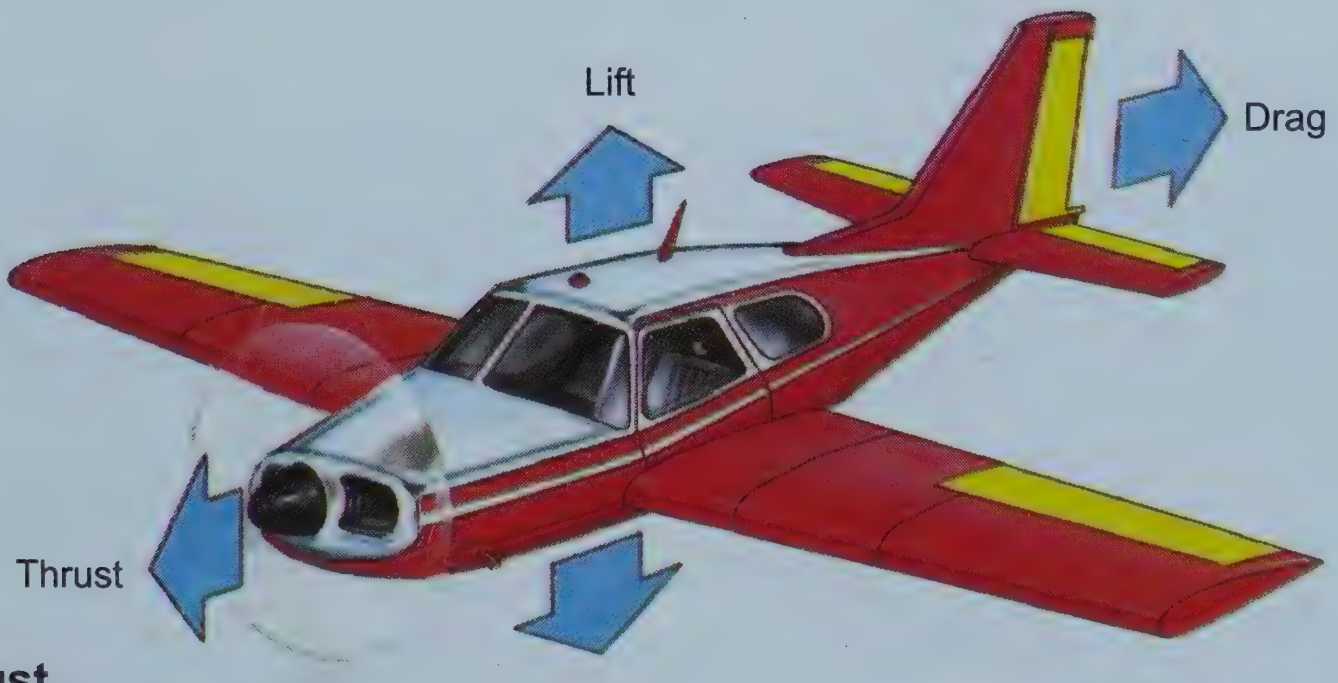
When a plane is flying, four forces keep it flying straight and level. These are lift and weight and thrust and drag.

Lift

Air rushing over the top of the wings and pushing from below lifts the palne.

Drag

The force of the air pushing against the plane when it is flying forwards is called drag.



Thrust

The propeller pulls the plane forwards through the air. This force is called thrust.

Weight

The weight of the plane pulls it down to balance against the lift.

"But how do the airplanes see each other? There is no such 'road' by which they travel!" - Anu asked. By this time she had forgot the loss of her gas balloons.

Of course there are roads, an invisible road called airroute. The planes always keep a distance of 600 meters between them. The route is selected by considering the climate, distance and height of travel. A radar follows the plane always when the plane is in the sky. You know, railway have cabins to control the train movement; in case of airways, it's called a control tower."

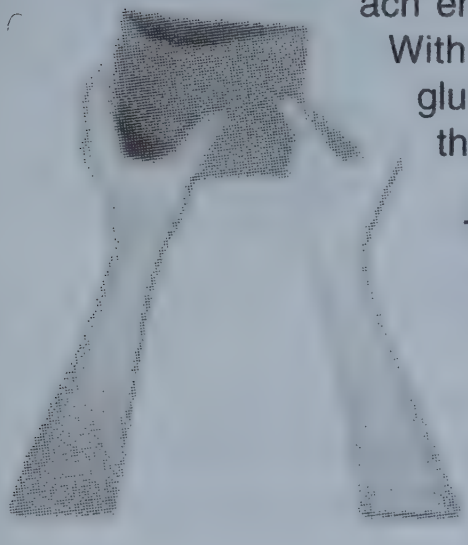
"I never knew it was so compleceted. But what about helicopters?"

"The mechanism of a helicopter is different. It has several facilities. It can take a turn very fast, can stay steady in the air and it takes very small space to land."

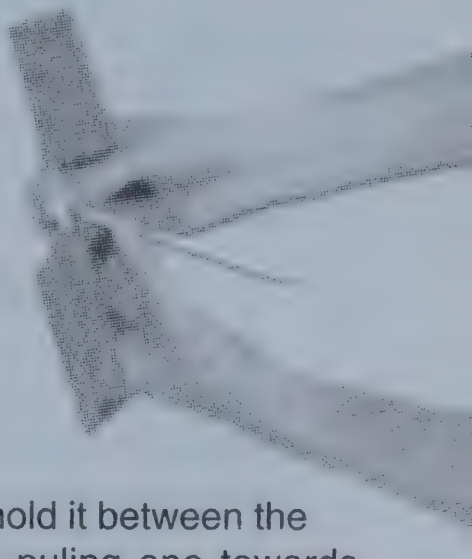
Activity Page

Make two small airfoil (4"-3") like the right pic. Fold each piece with an overlap.

Push the overlapping edges together. One side will curve up like a wing.



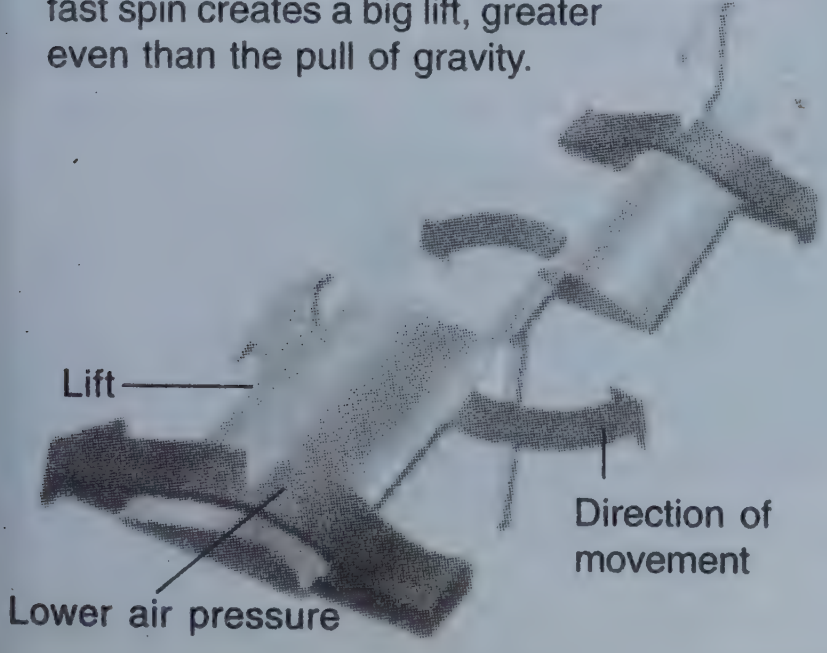
Spread a little glue onto ach end of a stiff straw or thin stick. With the curved side pointing up, glue them onto the straw so that they face in different directions.



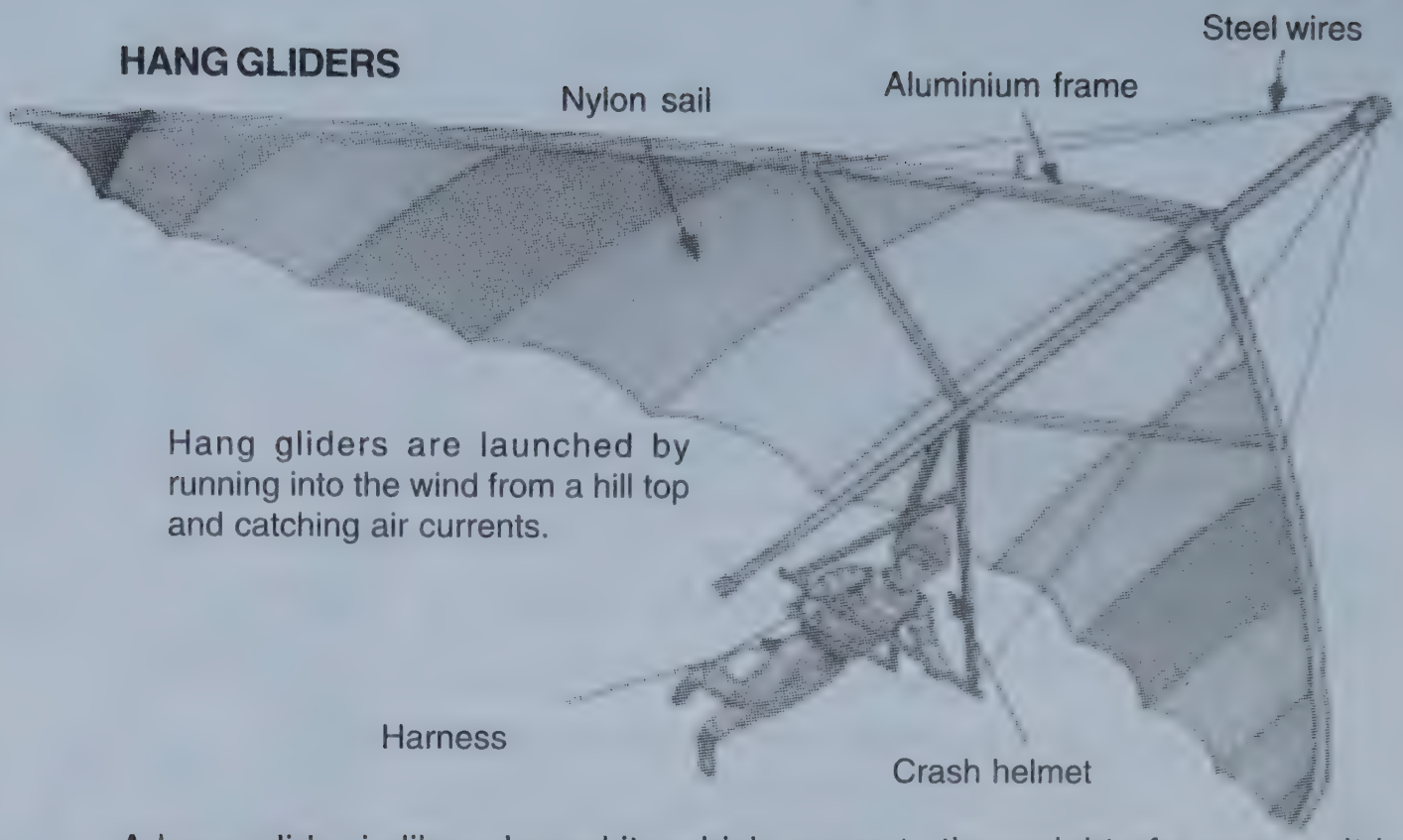
Tape another straw to the one holding the wings. Use a piece of modelling clay to weigh down the end. This keeps the whirligig level.

To send the whirligig spinning, hold it between the palms of your hands together, puling one towards you and pushing the other away. As your hands come apart, whirligig is releasd, twirling as it flies.

How it works: As you twirl and release your whirligig give it lift. The shape of the airfoil cuts through the air smoothly, but the bulge on the top, stirs up the air, creating low pressure above. The air pressure beneath the wing is higher than the top and pushes the whirligig skyward. A fast spin creates a big lift, greater even than the pull of gravity.



HANG GLIDERS


Steel wires
Nylon sail
Aluminium frame
Hang gliders are launched by running into the wind from a hill top and catching air currents.
Harness
Crash helmet

A hang glider is like a large kite which supports the weight of a person. It is made from a nylon sail and a light aluminium frame. The pilot hangs from the frame in a harness and steers by swinging his body about under the sail.

Rockets follow the principle of Newton's 3rd law. The liquid fuels (a mixture of helium and hydrogen) of a rocket is burnt. The fuel gushes out downwards which gives a thrust to the rocket and the rocket moves upward. The thrust given by the fuel on the side walls of the engine cancels out each other.

Chapter 6 World on the Palm

After coming back from Mauripur, Anu missed her cousins a lot. One evening, sitting with her friends and her mother, she thought of calling her cousins. She went to the phone, dialled the number hurriedly but a recorded voice said - 'All lines in this route are busy.'

"Oh no! I wish I could send my message to them by a pigeon".

"Pegion, ha..ha..How is that possible?" -Madhu laughed

"Have you not seen in historical movies that kings and princes used to send letter through trained pigeons to their near and dear ones" – Anu tried to explain.

"Did they? I had no idea! I thought man used animals only for transportation."

"Isn't sending letters a form of transportation?" Anu asked.

"How?" Natasha also could not understand.

"What dose transportation actually means?"- Anu threw the question.

"It means carrying things and people from one place to another" Ali told.

"Yes and no. Transportation may include Communication too." -Anu sounded weird to her friends.
"Movement of messages and ideas from one place to another is also a transportation. Sometimes the medium

is moving, like bus, train, postman etc. But sometimes they can be fixed, but the thing you want to transport is moving through that medium."- Anu concluded.

"Like movement of oil or water through pipeline. Transport of electricity or email or voice" – Madhu exclaimed.

"I know some more interesting ways of communication", Ali started. "Many tribes used fire symbols or conveyed messages by striking drums in various manners."

"Yes, as in the stories of Phantom", Madhu chipped in.

"So, where did the first postal service start, aunty", Natasha wanted to know.

"In China, around 900 B.C." Mother told the group "around 776 B.C. the pegions were used. Today when we, talk of communication, radios, TVs, fax, Telephone all of these come to our mind. But it was only in 1831 that electric telegraph was invented by Joseph Henry".

"Was it not Alexander Graham Bell who invented telephone?" Ali asked.

WHAT IS A RADIO?

In 1902 Gugleimo Marconi brought the electro magnetic waves to practical use and made a wireless set. When a man speaks in the studio, the sound waves coming out of his mouth are converted into electrical waves by microphone. They are mixed with high frequency electro-magnetic waves. These mixed waves are called modulated waves which spread in all directions by the antenna of the the transmitter. When these waves reach the antenna of our radio receiver, they produce electric current in it. The Radio receiver detects the signal and converts it to sound waves.

"Humm ...in 1876, I think" - Ma recollected.
"My papa was saying that it had changed the world of communication. In many cases telephone calls substitute a visit. Now one need not to go to someone's house to deliver a message. He can just make a call." Ali commented.

Do it yourself

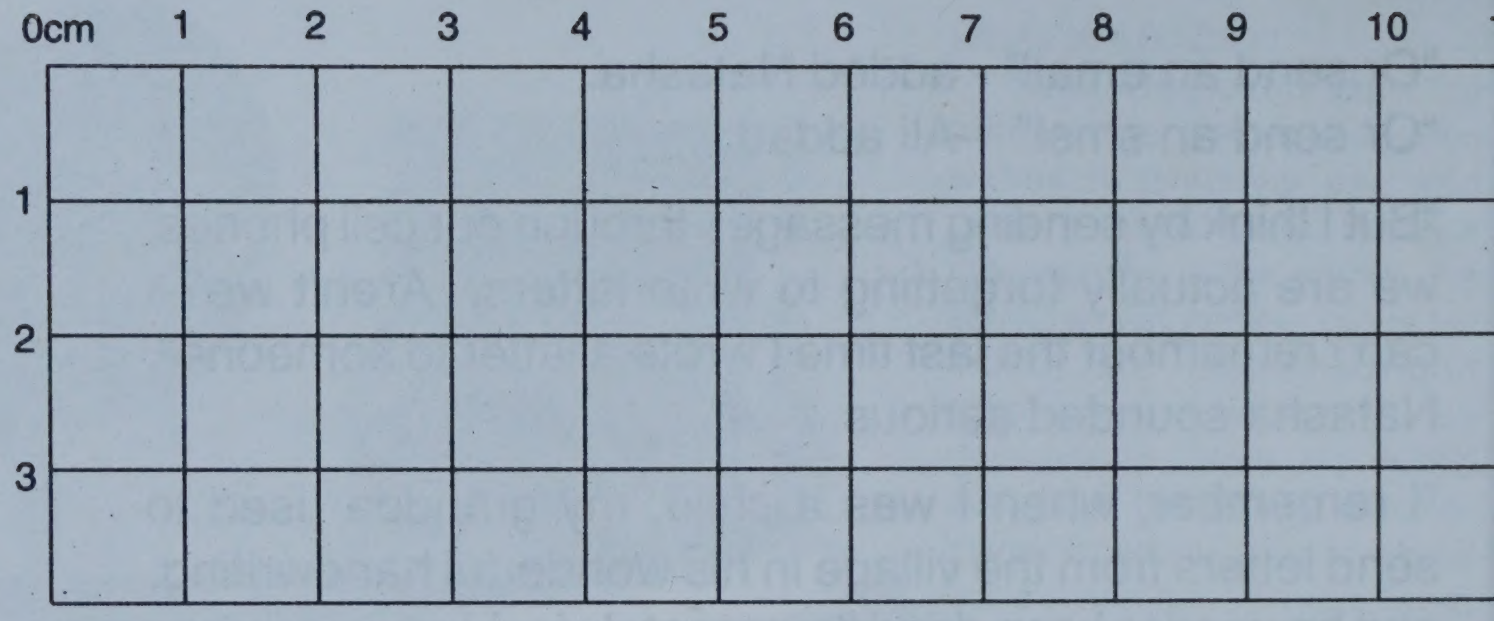
List down all the means of transportation/communication you use everyday. What is the energy consumption for that? Try to list down in a ascending way.

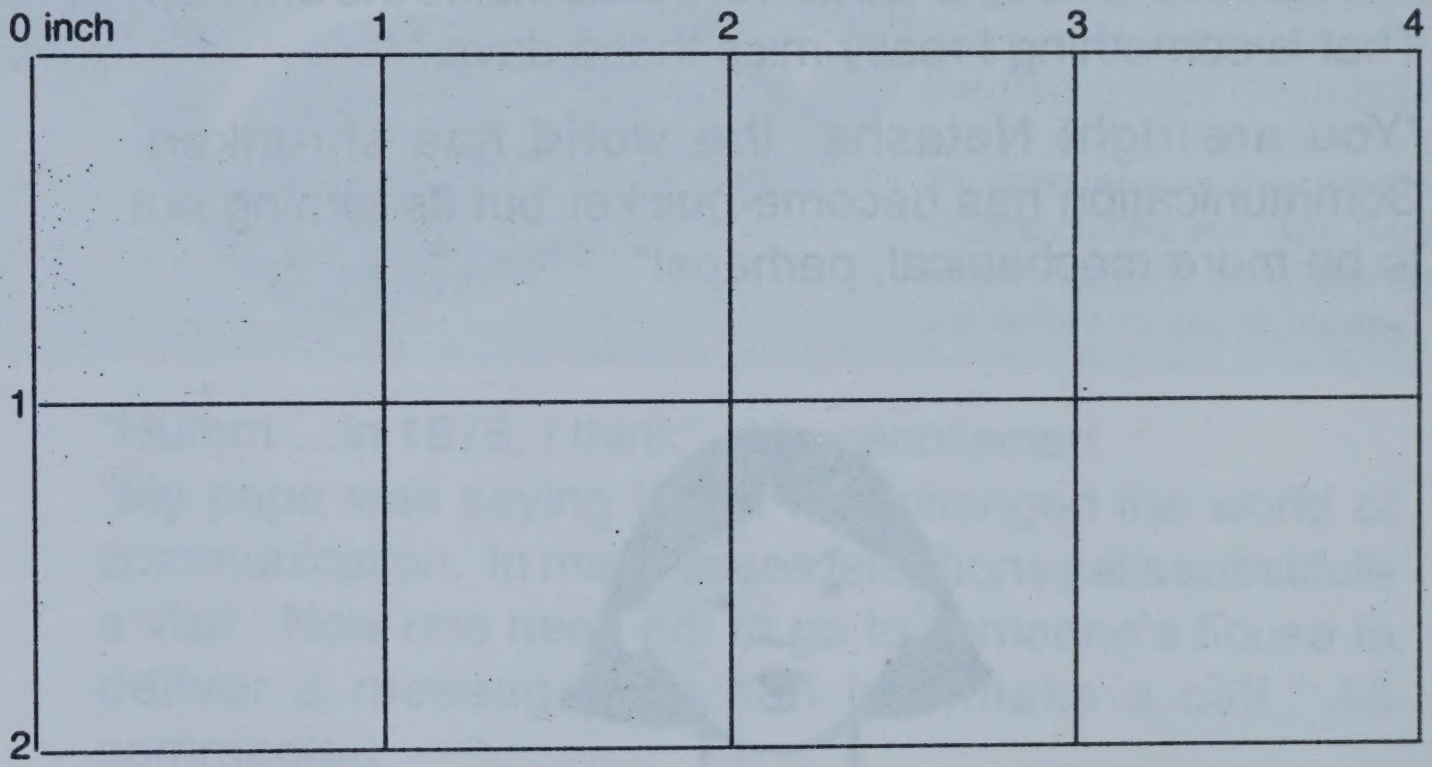
"Or send an email" - added Natasha.
"Or send an sms!" – Ali addad.

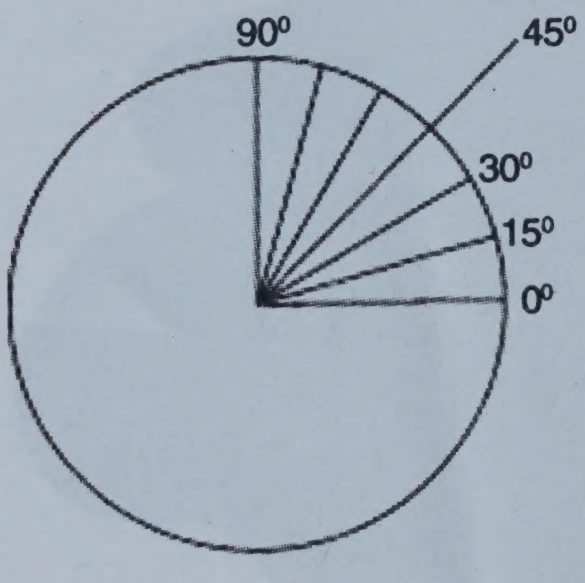
"But I think by sending messages through our cell phones, we are actually forgetting to write letters. Aren't we? I can't remember the last time I wrote a letter to someone", Natasha sounded serious.

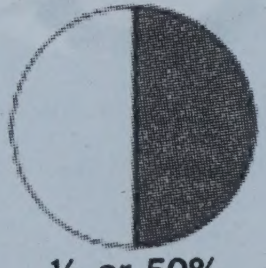
"I remember, when I was a child, my grandpa used to send letters from the village in his wonderful handwriting, and he used to keep dried flower petals inside the envelop. That is something I really miss these days."

"You are right Natasha, the world has shrunken, Communication has become quicker but its turning out to be more mechanical, perhaps!"









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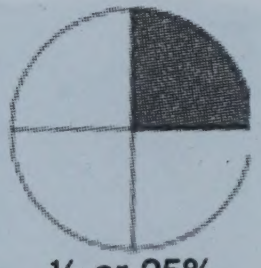

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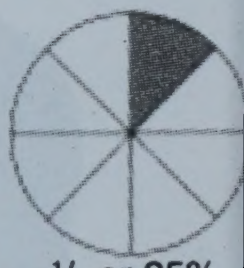

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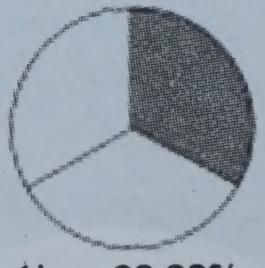
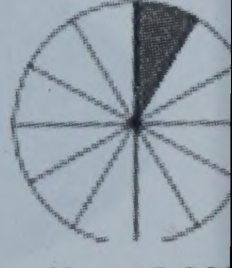


$^1/_3$ or 33.33%

$^1/_6$ or 16.66%



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